Psychopathology Notes Write Up

Introduction To Psychology: Physiological & Cognitive Psychology (University of Queensland)

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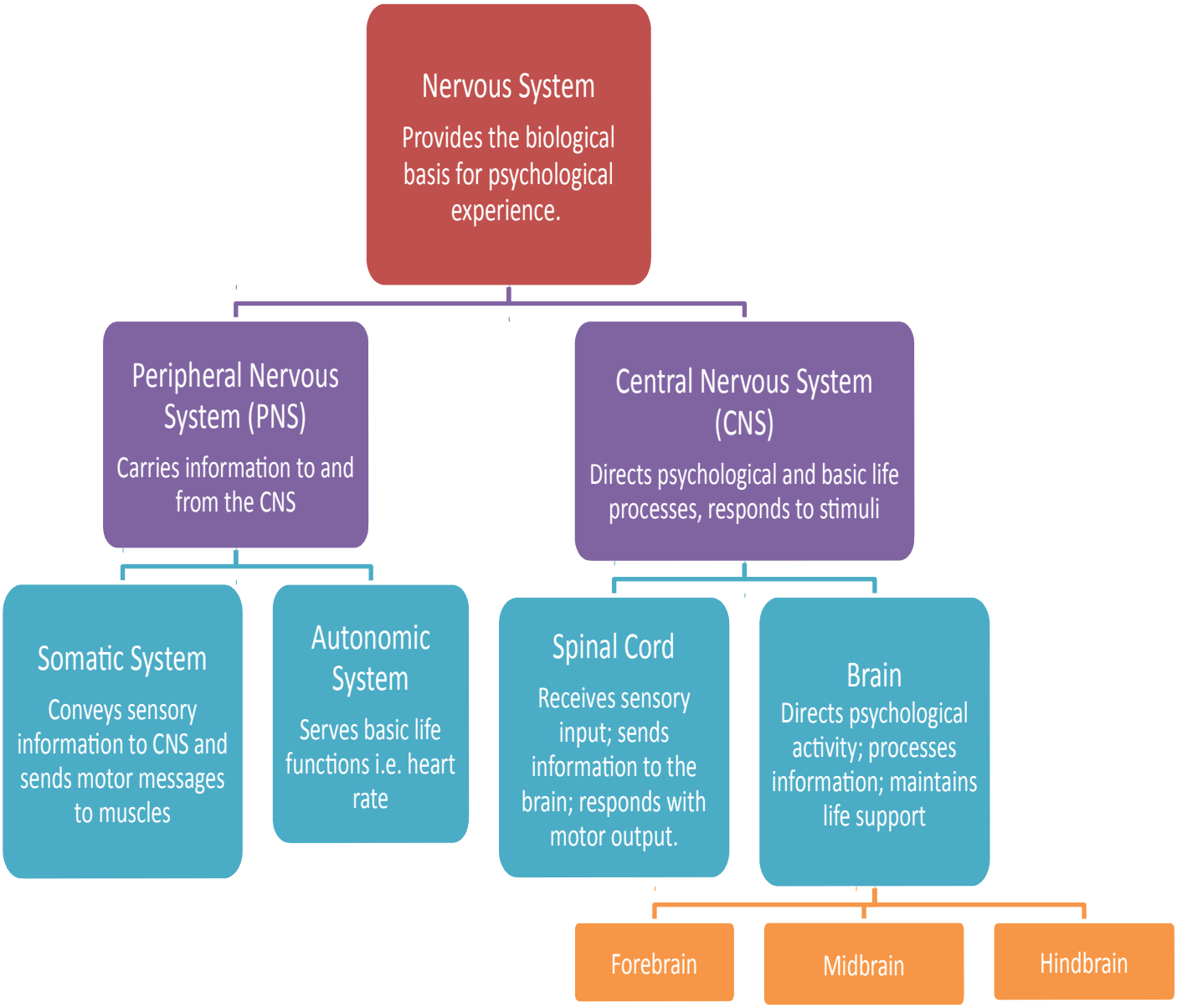
Neuroanatomy

The Nervous System


Nervous System
Provides the biological basis for psychological experience.
Peripheral Nervous System (PNS)
Carries information to and from the CNS
Central Nervous System (CNS)
Directs psychological and basic life processes, responds to stimuli
Somatic System
Conveys sensory information to CNS and sends motor messages to muscles
Autonomic System
Serves basic life functions i.e. heart rate
Spinal Cord
Receives sensory input; sends information to the brain; responds with motor output.
Brain
Directs psychological activity; processes information; maintains life support
Forebrain
Midbrain
Hindbrain

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Forebrain

Thalamus
Relays sensory messages to the cortex

Hypothalamus
Responsible for regulating emotions and drives i.e. hunger, sex, aggression

Cerebral Cortex
Thin outer layer responsible for most complex behaviour and higher mental processes

Basal Ganglia
Involved in the control of movement and also plays a part in 'automatic' responses and judgements that may normally require little conscious attention. Includes the caudate necleus, putamen and globus pallidus.

Limbic System
Includes septal area, amygdala and hippocampus. The amygdala is crucial to the experience of emotion. The hippocampus commits new information to memory.

Hindbrain

Medulla Oblongata
Responsible for breathing, heartbeat and other vital functions

Pons
Involved in respiration, involuntary movement, waking, sleep and dreaming

Cerebellum
Co-ordinates fine muscle movement, balance, some perception and cognition. Stores procedural memories (motor learning)

Reticular Formation
Helps screen incoming sensory information and controls arousal. Involved in sleep.

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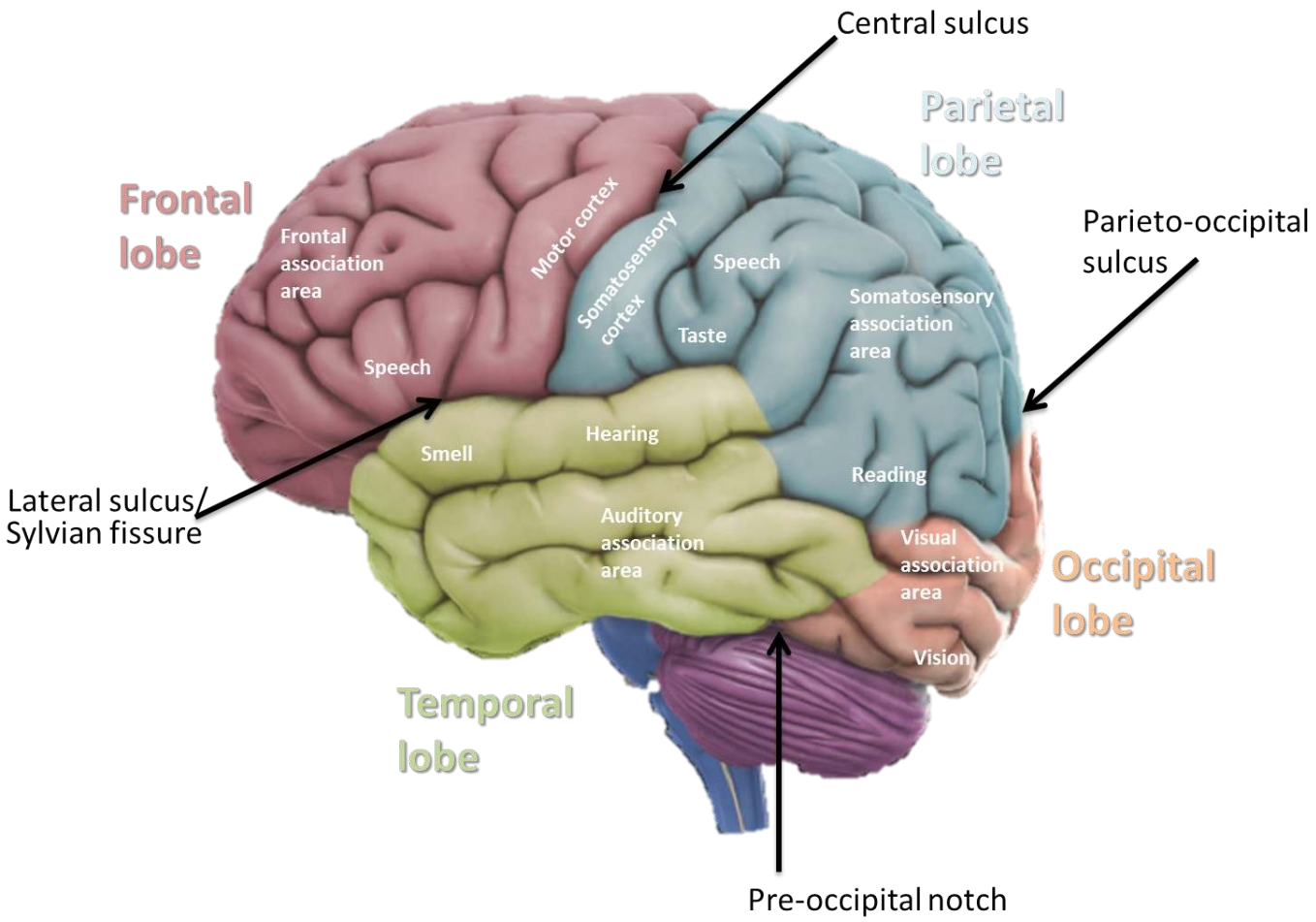
Corpus Callosum

Thick band of neural fibres connection the two hemispheres of the cerebral cortex. Acts as a bridge.



Broca's Area

Specialises in movements of the mouth and tongue. Located in the left frontal lobe at the base of the motor cortex. Necessary for speech production (mouth muscle control).

Wernicke's Area

Located in the left temporal lobe. Centre for speech logic.

Frontal Lobe

- Co-ordinates and initiates movement
- Attention
- Planning
- Social skills
- Abstract thinking
- Memory
- Aspects of personality

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Parietal Lobe

- Sense of touch
- Perception of movement
- Location of objects in space

Occipital Lobe

- Vision

Temporal Lobe

- Hearing
- Language
- Recognition of objects by sight

Primary Motor Cortex

Contains three areas:

- Primary – planning
- Pre-motor - selection of movements
- Supplementary – bimanual co-ordination

Primary Somatosensory Cortex

Responsible for processing pressure, pain and temperature. Receives information from the parts of the body.

Visual Cortex

Processes form, motion, orientation, colour, object, identification. Never works on its own; always integrated. Vision links to memories or other processes. Contains accurate spatial 'map' of visual world.

Auditory Cortex

Processes faces as well as sound frequency, location, music, prosody, oral language.

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Neurons

- Neurons process information
- ~100 billion in adult brain
- >100 trillion neural connections

Two categories of cells:

- Neurons
- Glial Cells

Glial Cells

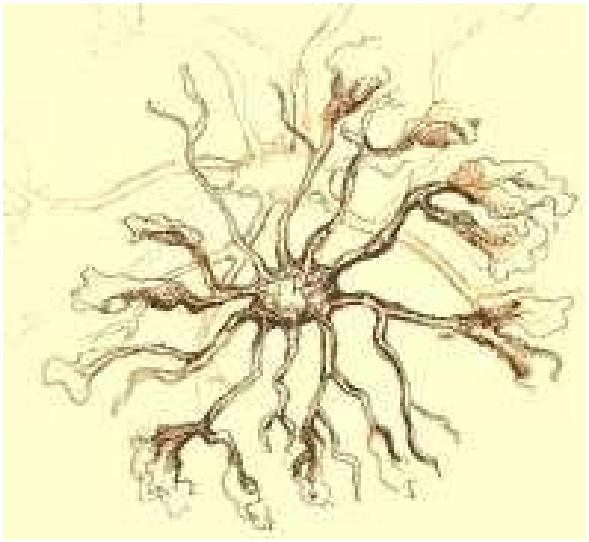
- Provide physical structure and support functions
- Allow neurons to survive

“Nerve glue”

Three important types:

- Astrocytes
- Microglia
- Oligodendrocytes

Astrocytes



“Star cell”

Provides structural integrity.
Creates “blood-brain barrier” by sealing off capillaries.

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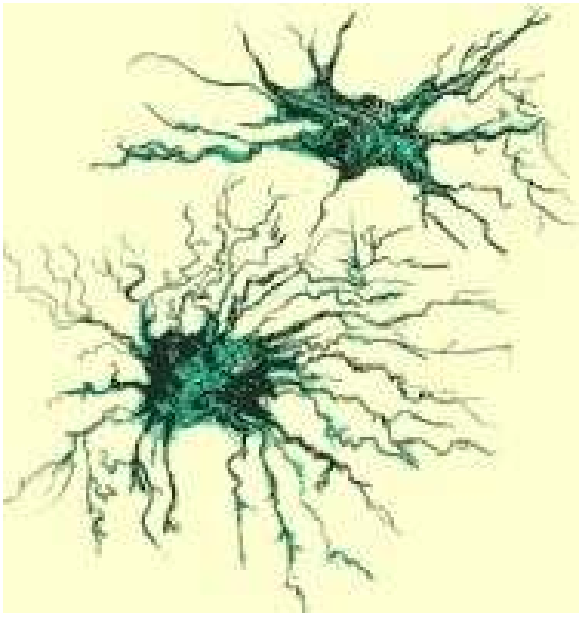
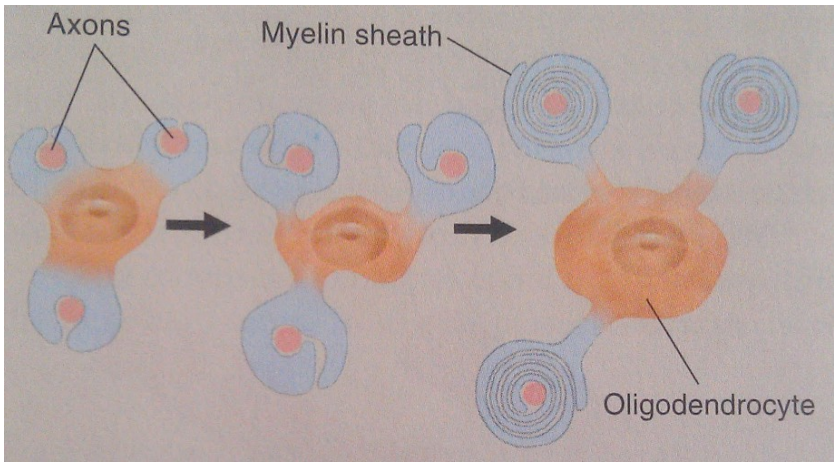
Microglia



Brain's immune system.
Activates to stop pathogens.
Eliminates wastes products.
Can move around.

Oligodendrocytes

Produce a fatty substance called 'myelin' which wraps around axons in layers.



Neurons

4 main parts:

- Soma (cell body)
- Dendrites
- Axon
- Terminal Boutons

Soma

- Common to all cells
- Contains nucleus and all structures necessary for cell function.
- Stores machinery to function

Dendrites

- *Dendron* (Greek for tree)

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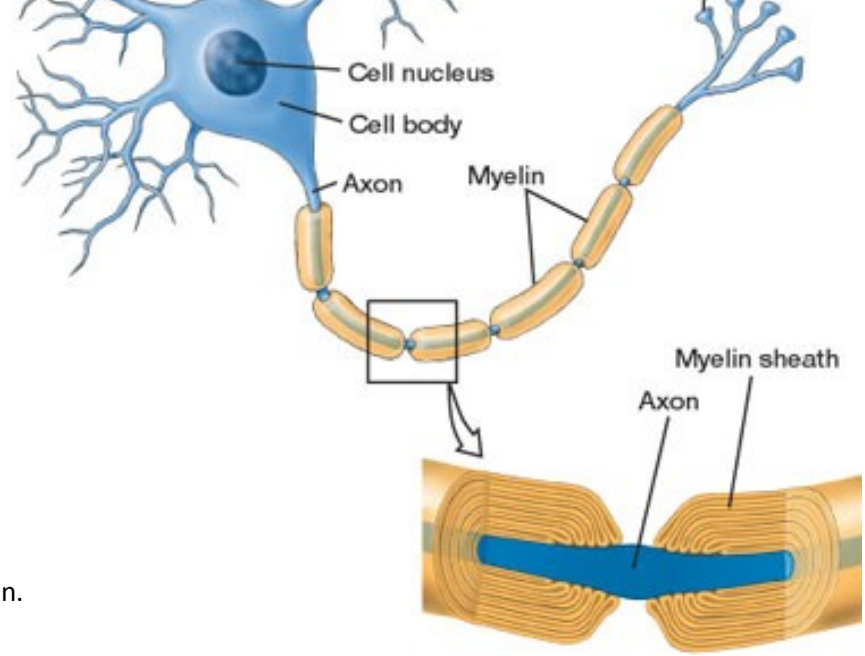
- Unique to neurons
- Serve as input to neurons
- Receives messages via neurons



Axon

- Unique to neurons
- Serve as output to neurons
- Use electrical potentials
- One axon per neuron

Terminal Boutons

- 'Terminal Buttons'
- Forms synapses with another neuron.
- Sends information to that neuron
- Secretes neurotransmitters when and action potential reaches them.

Neuron Communication

1. Neurons are nerve cells that transfer information within the brain.
2. Neurons use two types of signals to communicate:
    a. Electrical signals (long distance)
    b. Chemical signals (short distance)

Types of communication:

- Resting potential
- Action potential
- Myelination

} Electrical signals

- Neurotransmitters

} Chemical signals

Messages are transmitted as changes in membrane potential.

How do neurons talk?

Step 1

- Regulating ion flow creates a **resting membrane potential**
- Meaning a voltage difference between the inside and outside of the neuron (~75mv)
- Meaning a tiny battery

Step 2

Excitatory and inhibitory messages from other neurons (via dendrites) change resting potential. If enough excitatory messages are received, resting potential will exceed a threshold (~-55mv).

Step 3

This initiates rapid depolarization at the axon hillock which creates a current that moves down the axon. This current is called an **action potential.**

Step 4

THE PROBLEM

For a number of reasons the charge sent down the axon wouldn't travel far or fast enough if not for some help.

THE SOLUTION

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1. One form of help comes from the oligodendrocytes that form the myelin sheath
2. The *Nodes of Ranvier* act like amplifiers that regenerate the action potential

Step 5

Ultimately, the current reaches the end of the axon. While communication within the neuron is purely electrical, this is not how it goes between neurons. Arrival of action potential at presynaptic axon terminal triggers release of chemicals (neurotransmitters).

Step 6

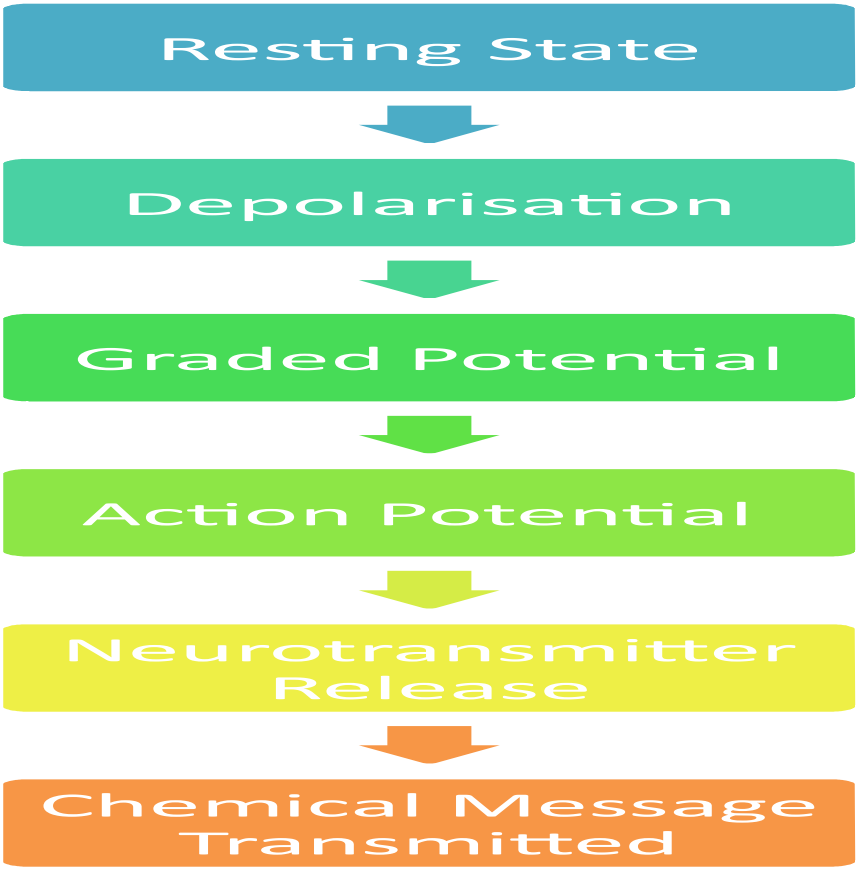
Neurotransmitters enter the synaptic cleft and float through cerebrospinal fluid. Some then bind with receptors on dendrites of adjacent neurons.

Step 7

Depending on the neurotransmitter and dendrite, one of time things will happen:

1. Excitatory post-synaptic potential (EPSP)
   depolarizes postsynaptic neuron
2. Inhibitory post-synaptic potential (IPSP)
   hyperpolarizes postsynaptic neuron

Summary



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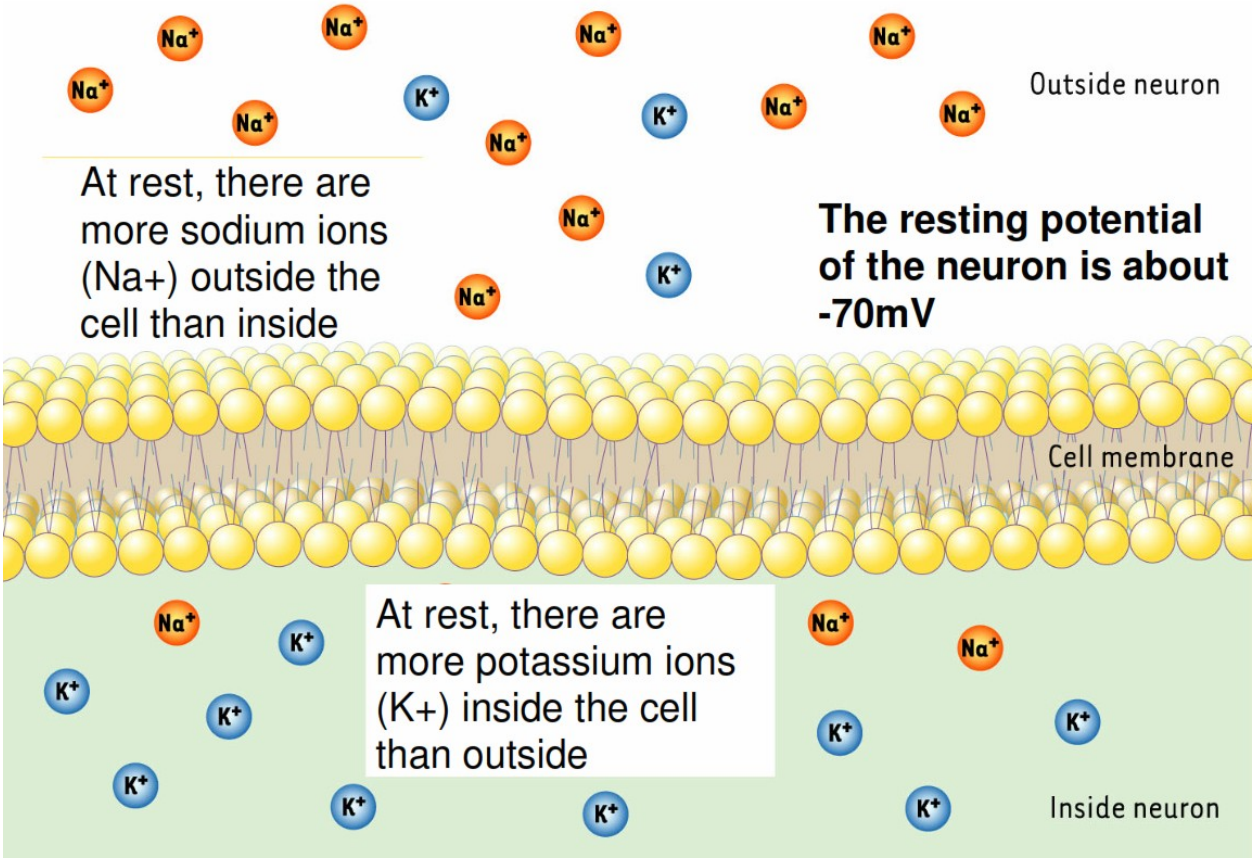
Resting Potential


Outside neuron
At rest, there are more sodium ions (Na+) outside the cell than inside
The resting potential of the neuron is about -70mV
Cell membrane
At rest, there are more potassium ions (K+) inside the cell than outside
Inside neuron

Action Potential

All-or-none principle:

- If the threshold level is reached, and action potential of a fixed size will always fire. For any given neuron the size of the action potential is always the same.
- Therefore, the neuron either does not reach the threshold or a full action potential is fired.

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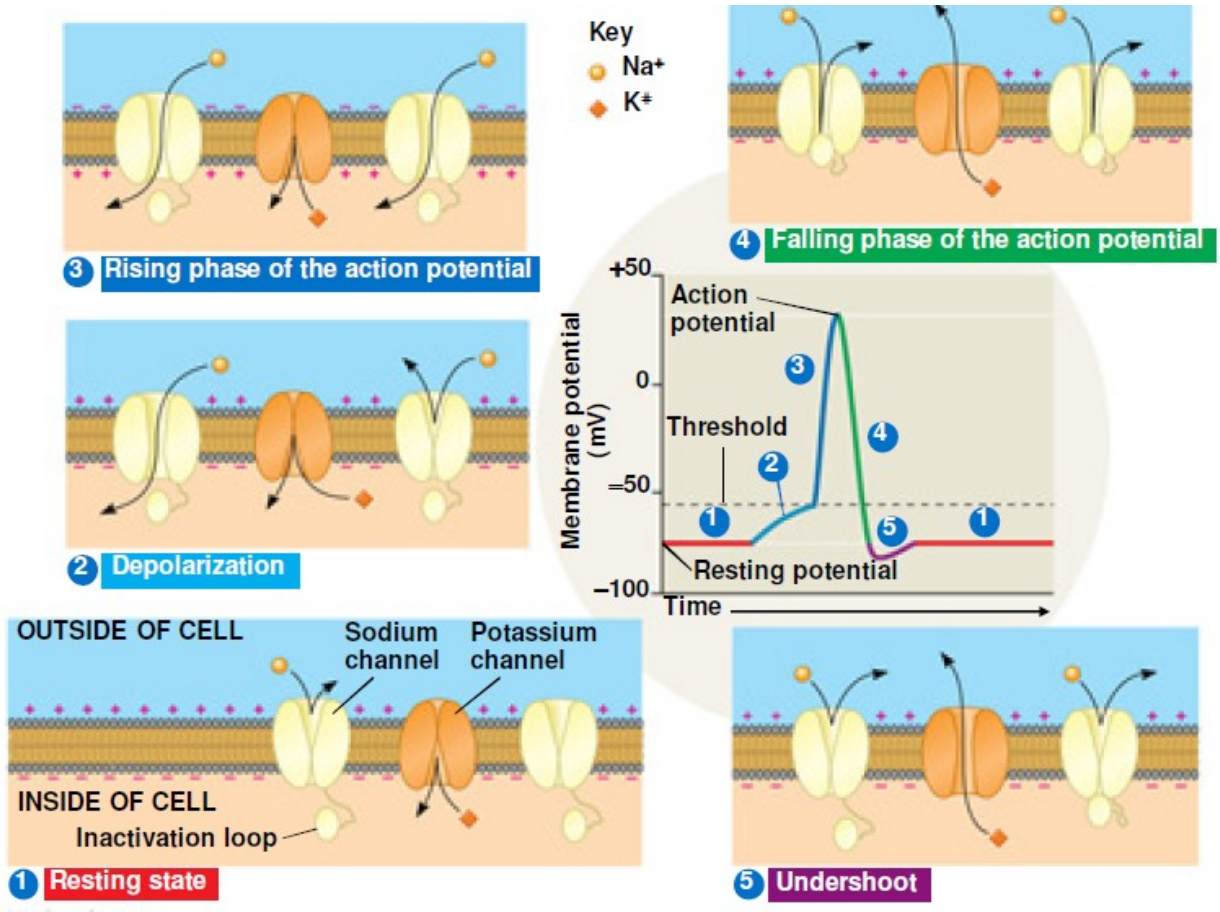
Stages of action potentials:



This continues down the membrane allowing the action potential to move along the length of the axon. Myelin sheath causes action potentials speed to increase. Action potentials are only formed at nodes of Ranvier. Action potentials in myelinated axons jump between the nodes of Ranvier in a process called salutatory conduction.

Neurotransmitters

Chemical signals.

List of common neurotransmitters:

- Glutamine
  - Excitation of neurons through the nervous system
- GABA
  - Inhibition of neurons to the brain
- Dopamine
  - Emotional arousal, pleasure and reward, voluntary movement, attention
- Serotonin
  - Sleep and emotional arousal, aggression, pain regulation, mood regulation
- Acetylcholine
  - Learning and memory
- Endorphins & Enkephalins
  - Pain relief, elevation of mood

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Physiological Methods

Conventional method: Lesioning

Modern methods:

- Single-cell recordings
  - Electrical activity (animals)
- EEG/ERP
  - Electrical activity (human)
- fMRI
  - Blood flow
- TMS
  - Activation/stimulation

Method	Invasive	Temporal Resolution	Spatial Resolution
Lesioning	Yes	No	Yes
Sing-Cell Recording	Yes	Yes	Yes
EEG/ERP	No	Yes	No
fMRI	No	No	Yes
TMS	No	Yes	Yes

Lesioning

Problems:

a) Injury often extensive
b) Impairment often extensive
c) 'compensatory' changes in other brain areas
d) Convenience sample
e) Doesn't take into account that the brain is a network

Logic: If are X does function Y, a lesion to X should impair function Y.

Single-Cell Recordings

- Record activity with spatial and temporal precision
- Only an option in non-humans

Mirrorneurons

Neurons involved in activities fire even when the activity is only observed. Only proven in monkeysss,,, however. Haven't been found in humans due to testing limitations.

EEG/ERP

Electroencephalogram (EEG)

- Electrodes placed on scalp records the electrical activity generated by groups of neurons firing action potentials.
- The EEG electrode amplifies electrical potentials occurring in thousands of brain cells.

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- Provides gross estimate of overall brain activity – used to determine whether someone is brain dead.

Event-related potentials (ERP)

- Involves looking at a specific section of the EEG signal that occurs in response to a particular event/stimulus.
- Only used for data.

fMRI

- Detects change in blood flow to areas of the brain. Provides structural and functional views of the brain.
- Relies on magnetic properties of blood to enable images of blood flow in the brain as it is occurring.
- Researchers can make 'movies' of changes in brain activity while patients perform various tasks or are exposed to various stimuli.

Blood
Oxygen
Level
Dependency

TMS

Transcranial magnetic stimulation.

- Uses focal magnetic fields (electrical current) to briefly stimulate the cortex.
- Creates a 'virtual lesion' – reversible
- Allows investigators to activate a specific area of the brain through electromagnetic induction.

Advantages to each

Neural networks –> fMRI

Precise time-course/temporal dynamics –> EEG

Explore brain-behaviour functions through reversible 'virtual lesions' –> TMS

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Cortex and Laterality

Hemispheric Specialization

Left-brain/right-brain

- Refers to specialized functions of the two hemispheres.

Lateralization of Function

- One side of the brain is more crucial for a given function and/or more efficient at the underlying computational tastes/
- Typically a matter of degree
    - Strongly vs. weakly lateralized
- Motor control is a goof example of lateralized function.

Contralateral Arrangement

Contralateral = cross

Motor: Right hemisphere controls left side of body and vice versa.

Language

Language is lateralized in the left hemisphere in ~85% of the population

Broca's area: Lateralization associated with enlarged 'pars triangularis'.

Wernicke's area: Lateralization associated with enlarged heschl's gyrus and plannum temporale.

Handedness

- Over 85% of people are right-handed
- Of these, nearly 100% have language lateralized in the left hemisphere. Some *do* have language lateralized in the right hemisphere.
- Which hemisphere controls language in non-right handers is complex. Generally:
    - 70% have it in the left hemisphere
    - 15% right hemipsher
    - 15% both hemispheres
- The more left-handedness is lateralized, the more language is lateralized in the right hemisphere.
- Gender difference:
    - 15% of all men are left-handed
    - 10% of all women are left-handed

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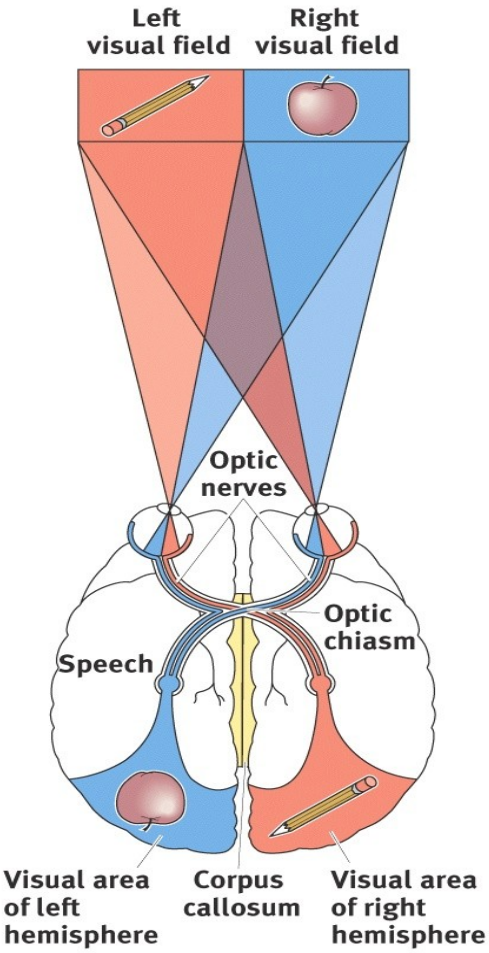
Split-Brain

- Right hemisphere controls left side of visual field.
- Left hemisphere controls right side of visual field.
- Right hemisphere = non-verbal
- Left hemisphere = verbal

Cannot report visuals in the left visual field which correspond with the right hemisphere.



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Brain Injury

The brain is surrounded by cerebrospinal fluid which acts as a protective cushion. Acquired Brain Injury (ABI)is used to describe all types of brain injury that occur after birth. Often called 'hidden disability' because it affects intangible processes like thinking and behaviour.

"Hidden Disability"

- Not physically visible
- Not easily recognised
- Often long term problems, usually in the areas of cognition and behaviour

ABI

Injury to the brain that results in deterioration of cognitive, physical or behavioural functioning.

Types of ABI:

- Stroke
- Anoxia
- Aneurysm
- Brain tumour
- Brain injury from drug or alcohol misuse
- Traumatic brain injury

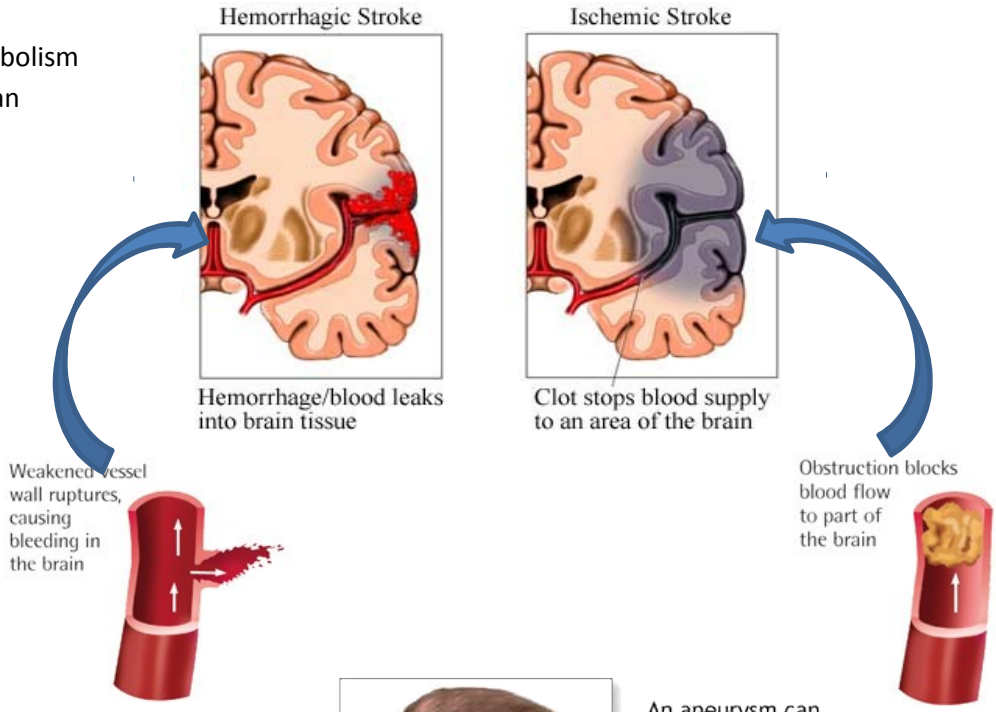
Excludes:

- Congenital disorders (intellectual disabilities, cerebral palsy)
- Progressive disorders (Alzheimer's, MS)
- Psychiatric disorders

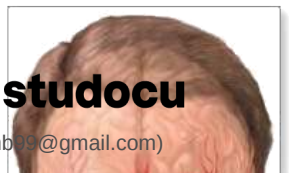
Stroke

Two broad types:

- Ischaemic – thrombosis or embolism
- Haemorrhagic – rupturing or an anuerysom


Hemorrhagic Stroke
Ischemic Stroke
Hemorrhage/blood leaks into brain tissue
Clot stops blood supply to an area of the brain
Weakened vessel wall ruptures, causing bleeding in the brain
Obstruction blocks blood flow to part of the brain

Haemorrhagic stroke



An aneurysm can occur in any blood vessel which supplies the brain

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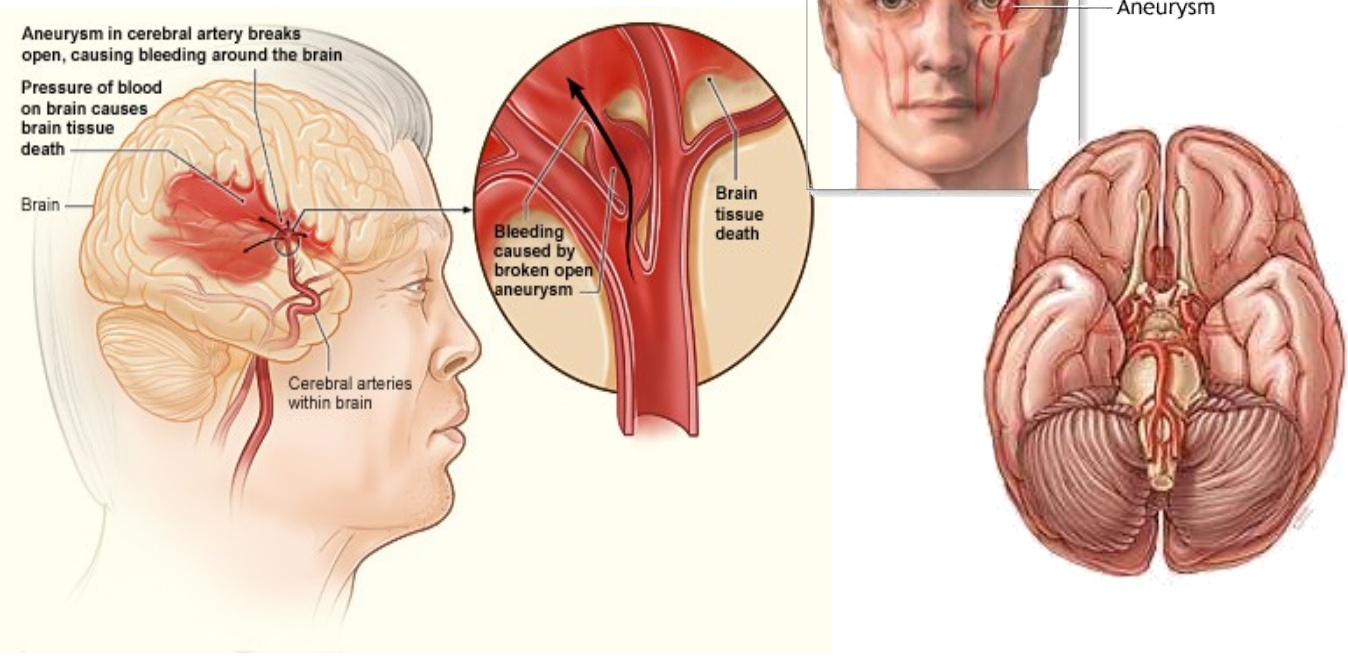
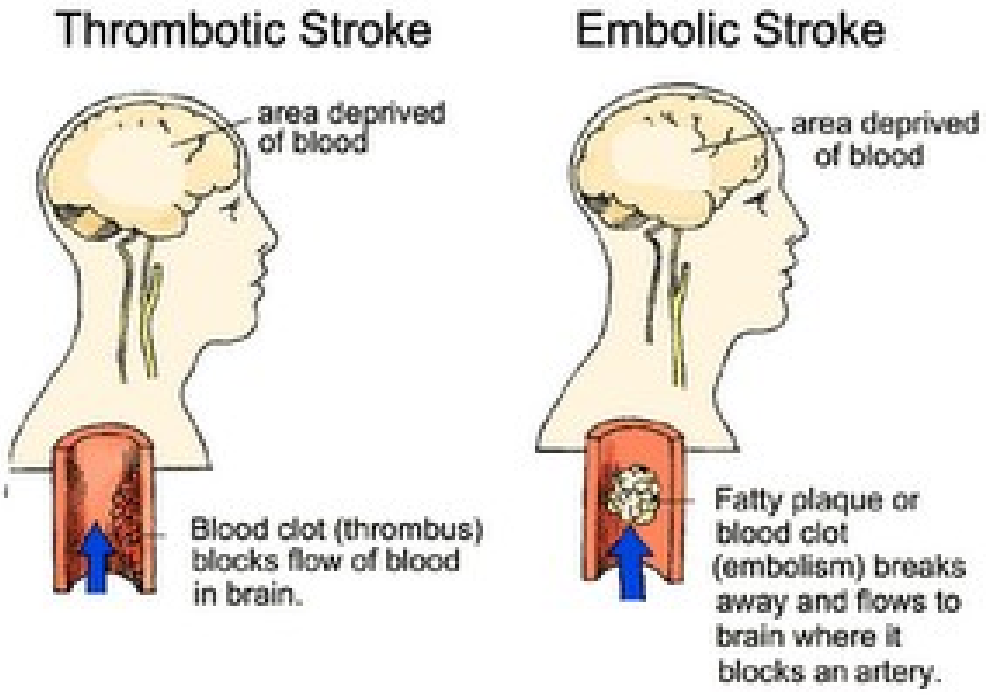

Aneurysm in cerebral artery breaks open, causing bleeding around the brain
Pressure of blood on brain causes brain tissue death
Brain
Cerebral arteries within brain
Bleeding caused by broken open aneurysm
Brain tissue death
Aneurysm

Ischaemic Stroke


Thrombotic Stroke
area deprived of blood
Blood clot (thrombus) blocks flow of blood in brain.
Embolic Stroke
area deprived of blood
Fatty plaque or blood clot (embolism) breaks away and flows to brain where it blocks an artery.

Traumatic Brain Injury (TBI)

- An acquired brain injury caused by physical damage to the brain, either as a result of a blow or toehr force to the head which results in damage to the brain or alteration in brain function.
- Bruising, bleeding, swelling or tearing of the brain tissue may occur.

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Caused by:

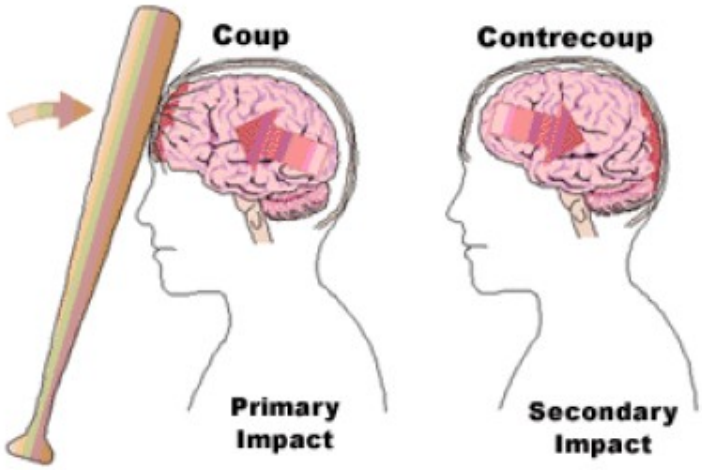
- Motor vehicle accidents
- Severe whiplash
- Shaken baby syndrome
- Falls
- Gunshot wound
- Concussion blast injuries

Types of TBI

- Primary effects involves the direct application of physical forces damaging:
  - Nerve fibres
  - Blood vessels
  - Other brain tissue

Primary causes can lead to many secondary complications

- Secondary complications include:
  - Haemorrhage
  - Increased intracranial pressure
  - Hypoxia (loss of oxygen below critical threshold)
  - Brain swelling
  - Post-traumatic epileptic seizures



Some Possible Consequences of Brain Injury

Physical effects:

- Fatigue
- Headache
- Paralysis
- Chronic pain

Cognitive effects:

- Memory problems
- Slowed responses
- Poor planning and problem solving
- Impulsivity

Emotional and behavioural effects:

- Irritability
- Socially inappropriate behaviour
- Depression

Neuroplasticity

- The capability of the brain to alter its functional organization as a result of experience.

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- Our brains can not only create new neurons (neurogenesis) but can change their structure throughout our lifespan.
- Exists at all level of the brain (cells, gene, behaviour)

Includes:

- The brains capacity to be shaped or moulded by experience
- The capacity to learn and remember
- The ability to reorganize the recover after injury

Environmental Influence

Experiment -> rats a) enriched b) impoverished

Dendritic growth (increasing probability of neuron connections) -> brain has remodelled itself in response to learning/environmental influences.
Rats in the enriched environment had an increase in dendritic growth.

Neurogenesis: new neurons migrate to different areas

Synaptogensis: development of connections with neurons (creation of synapses) -> brain is physically changing in response to new information.

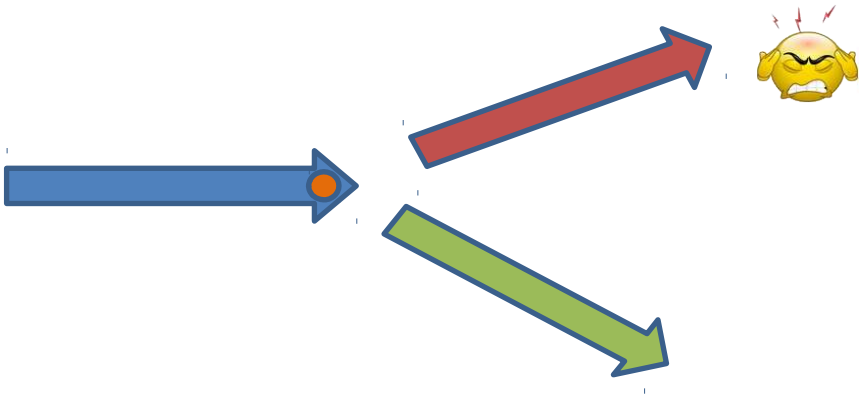
Hebb Rule

Neurons fire together wire together

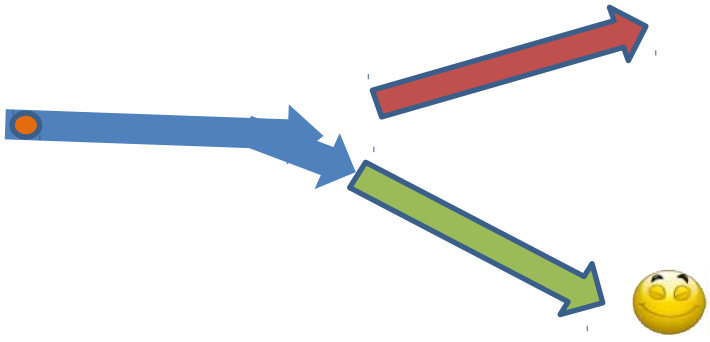
ASSOCIATION

Synaptogensis

- When a signal travels down the axon and reaches the synapse, it can go one of two ways.



- If this pathway is used a lot, the brain will rewire itself to make this signal path easier.
- Similarly, if you use a new pathway a lot, the brain will rapidly rewire itself to make this new pathway easier.



Neuroplasticity and Rehabilitation

- Neuroplasticity helps in recover from ABI as caused by stroke, etc.

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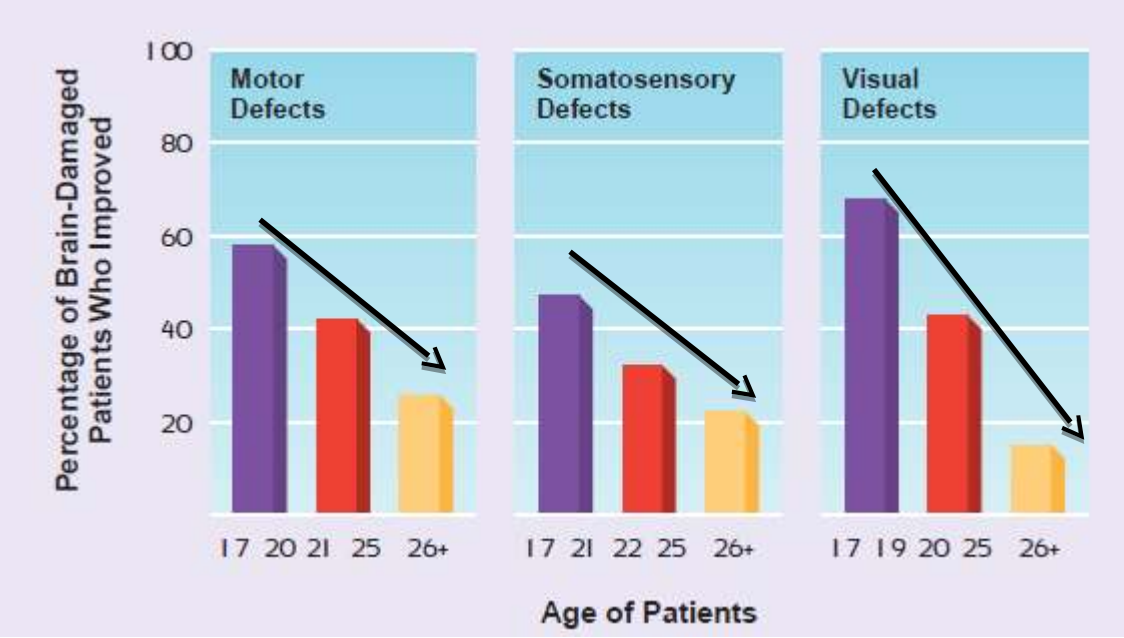
- Recent studies showed that brain cells surrounding the damaged area undergo changes in their functions and shape that allow them to take on the function of damaged cells (maladaptive plasticity).

Training can promote adaptive plasticity. Significant increase in the motor cortex, despite the lesion still being there. Training has been found to induce an increase in grey matter in the processing and storing of certain areas.

Age-dependent Determinant

Although plasticity occurs over an individual's lifetime, different types of plasticity dominate during certain periods of one's life and are less prevalent during other periods.



Clinical Application Considerations

Heterogeneity:

- Every person with ABI is different
    - Every individual is different prior to injury
    - Every injury is different

The individual is most important. Needs to be considered:

- What is important?
- Where do they need to adapt?

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Attention

What is Attention?

1. Attention as a gatekeeper to what we perceive and what we know.
2. Attention as a limited resources – we miss a lot more than we realise.
3. Attention is selective
4. Attention can be driven by external and internal processes
5. Attention is dependent on arousal
6. Automaticity of attention

Understanding Attention

- Process
- Limited Capacity
- Stimuli compete for limited resources

Attention as a Gatekeeper

Attending to something, where it means visually or as an internal process of intentionally focusing on something, or expectations, will affect the likelihood of us actually processing something among other things.

Capacity Limitations

- Limitations in the ability to process, perceive and respond to several sources of information simultaneously
- General research strategy: divided attention tasks
- Dual tasks: subjects perform tasks individually and at the same time
- Tasks that require attentional capacity will interfere with each other in a dual task situation.

Selective Attention

- The ability to differentially process, perceive and respond to one of several sources of information available.
- General research strategy: selective attention tasks
- The 'Cocktail Party Phenomenon' – Colin Cherry

Broadbent (1958)

In contrast to visual attention, auditory information is received simultaneously. Need to focus on information that is important and ignore information that isn't – listen selectively. Auditory attention 'filters' information. Visual attention is very close to what you do attend to.

Dichotic Listening

What could be heard in unattended ear?

- If a voice is present
- Voice changes from man to woman
- Voice becomes a tone

What was not heard in unattended ear?

- Content of message
- Language of message

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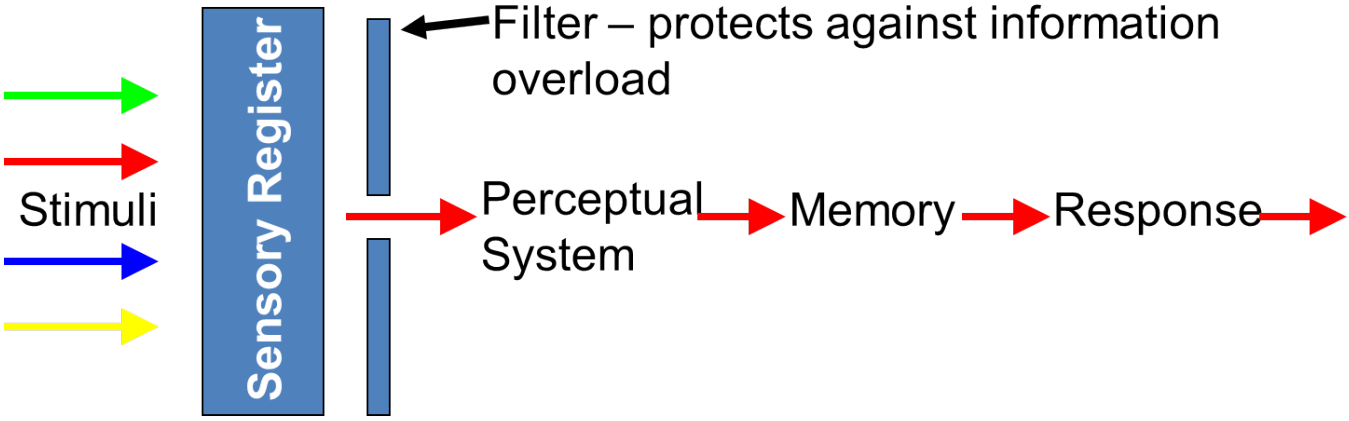
- Change in language of message
- Speech vs. nonsense backwards speech.

Thesis of Selective Attention

Broadbent's filter theory (1958)

- Early selection theory or "Serial processor"



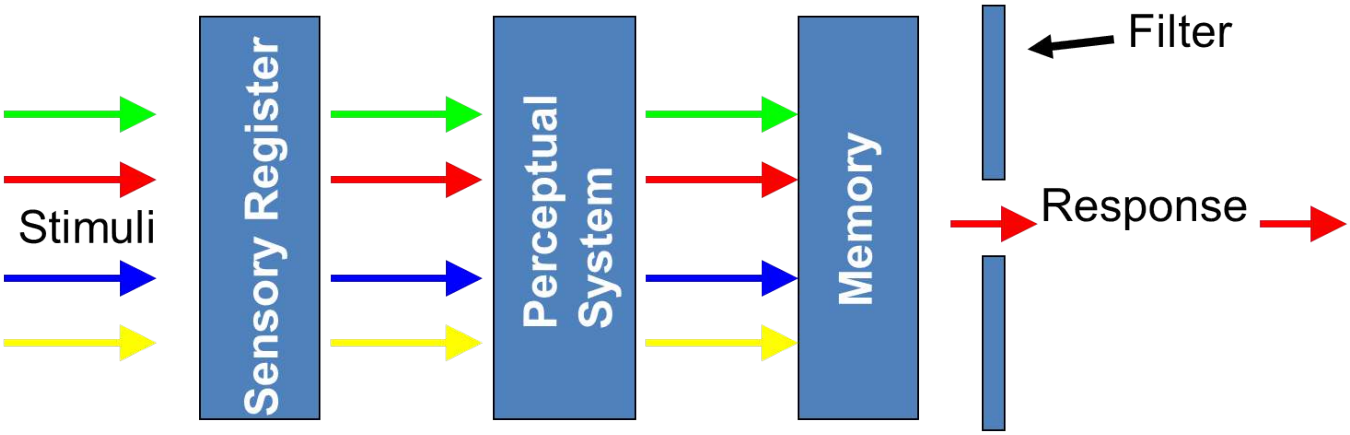
- Moray & Treisman (1961): included information such as the research subject's own name in the unattended ear and found that it was often heard, suggesting the unattended information may *not* be filtered out.
- Corteen & Wood (1972): further investigated the processing of 'important' information in the unattended ear.

Cocktail Party Effect

- Ability to selectively listen to one conversation during a party while ignoring the noise going on around you.
- Imagine you are talking to someone at a part. Suddenly someone says your name in another party of the room. You are able to immediately detect this, and switch your attention to that part of the room

Deutsch & Deutsch (1963)

- Late selection song or 'Parallel processor'



Corteen & Wood (1972)

- Two-phase experiment

Phase one: classical conditioning exercise

US->UR

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Electrical shock -> skin conductance
CS CR

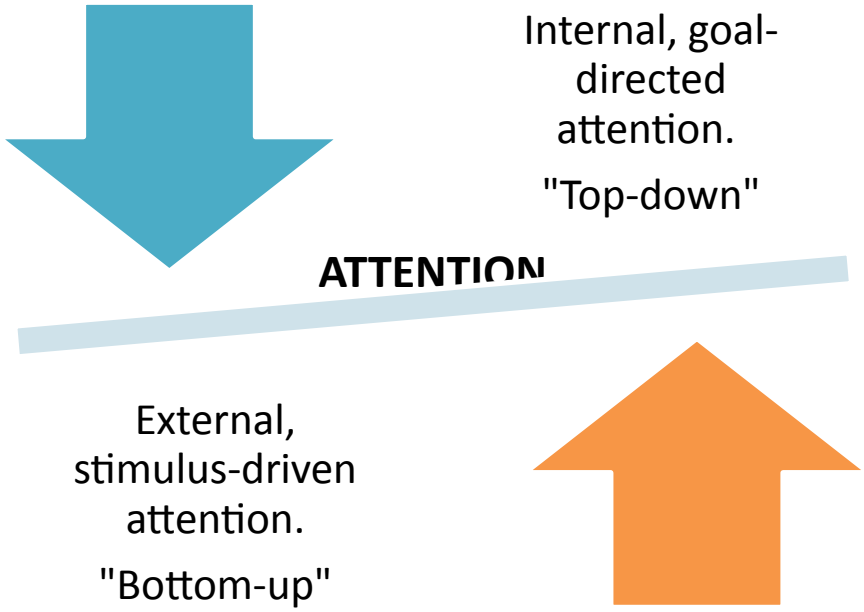
Phase two: Dichotic listening task

Presented conditioned (US controlled) words in the unattended message of the task.

Results:

- Participants couldn't report the unattended message – expected
- Did show a psychological response to unattended conditioned words
- Demonstrated that multiple channels of information we're getting through

Cognitive Control



Some external stimuli 'capture' our attention -> "Bottom-up" processing

Some internal thoughts and goals direct our attention -> "Top-down" processing

Alertness or Arousal

The variable of 'mental energy' or 'processing power' available.

General research strategy: manipulate arousal and measure performance. Usually measured physiologically i.e. raised heart rates means raised arousal.

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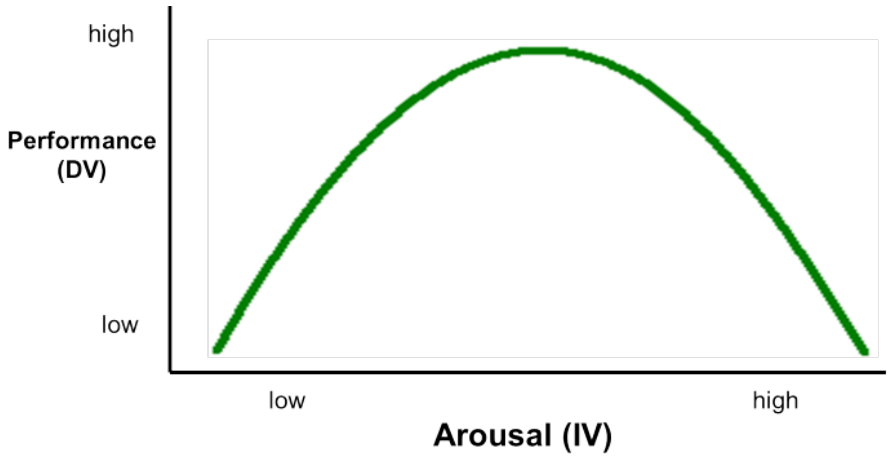
The Yerkes-Dodson Law

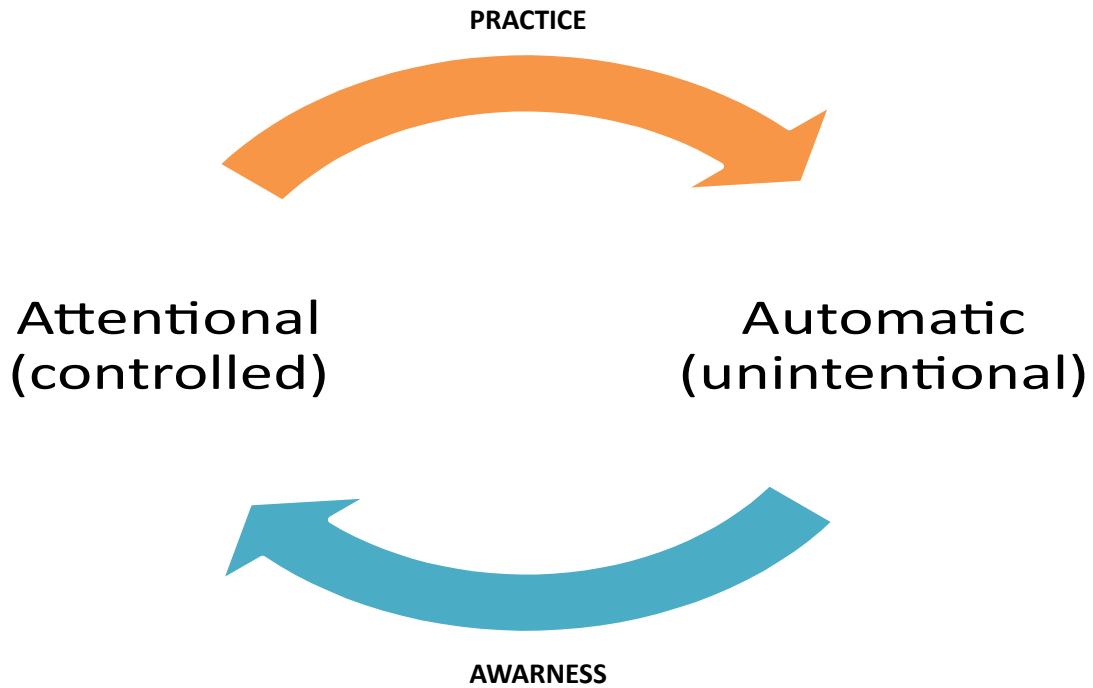


Performance is at a peak at an intermediate level of arousal

Attentional vs. Automatic Processes

	Attentional	Automatic
Selectivity	Optional	Obligatory
Capacity	Effortful	Effortless
Alertness	Show effects	Show little effects
Speed	Slow	Faster
Information flow	Serial	Parallel
Awareness	Conscious	Unconscious
Flexibility	Flexible, variable	Uniform, rigid

The higher your want to do something, the more automatic it is.



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Emotion

Definition

"Short-lived response to environment involving physiology, subjective experience, behavioural/emotional response."

Affect: behavioural response to emotion
Mood: pervasive, longer lasting emotional state

Emotional Expression

Facial expressions:

The relationship between facial expression and emotion seems universal

Six fundamental emotions:

- Anger
- Sadness
- Happiness
- Surprise
- Fear
- Disgust

Physiological arousal = emotions

How do emotions occur?

James- Lange Theory:

Emotion comes from appraisal of autonomic and behavioural response

Stimulus -> physical response -> emotional response

Canon-Bard Theory:

Emotional reaction and physiological reaction occur together

Stimulus -> physical response + emotional response

Schachter-Singer Theory:

Emotional reaction occurs from cognitive appraisal of physiological arousal

Stimulus -> physiological arousal -> cognitive appraisal->emotional response

Emotion Driving Attention

Allocation of attention reflects personal relevance of images rather than their content (Dr Who study).

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Paradigms in Psychology

Paradigm	General Definition	Focal Topic(s)	Language & Concepts	Methods	Influences	Root Metaphor
Behavioural	The scientific study of behaviour	Learning	Stimulus; response; conditioning; reinforcement; shaping	Experimental – mostly animal	Prior: Mentalism Contemporary: Other sciences – especially Darwinian biology	*Tabula rasa* Blank slate; lump of clay
Cognitive	The scientific study of mental processes as shown by behaviour	Perception; attention; memory; thinking	Input; output; codes; serial processing; memory stores	Experimental – mostly human	Prior: Mentalism Contemporary: Computer science – especially artificial intelligence	Programmed computer
Biological	The scientific study of the biological bases of behaviour	Behavioural topics; cognitive topics	Biological, behavioural terms and cognitive terms	Experimental (where possible); case study; correlational	Prior: Behavioursim Contemporary: Neroanatomy & physiology; cognitive persepective	Biological machine
Psychodynamic	The study of conscious and unconscious processes as seen in 'mental illness'	'Mental illness'	Ego; id; super-ego; defence mechanisms – repression, projection, etc.	Case history	Prior: Philosophy Contemporary: Victorian cultures, medicine, Darwinian struggle to survive	Mental illness; fluid dynamics
Humanistic	The study of conscious human experience	Individual awareness; conscious choices; well-being	Personal growth, self-actualisation, awareness, transcendence, free will, human potential	Case history	Prior: Psychodynamic, behaviourism Contemporary: '1960's' cultures, existentialist & Eastern philosophies	Growth

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Consciousness

Paradigms of Consciousness

- Introspection – William James
- Psychoanalytic – Freud
- Behavioural – Skinner
- Cognitive – Bernard Baars
- Neuroscience/Biological – Antonio Damasio

Definition

It has something to do with:

- How we monitor our various perceptions, thoughts, emotions, goals, etc.
- How we regulate ad control our behaviour

Steps in when our automatic processes fail.

Altered States of Consciousness

- Drugs
- Daydreaming
- Hypnosis
- Meditation
- Dreaming

Drugs

- Depressants
    - Depress CNS function

      e.g. alcohol, morphine
- Stimulants
    - Stimulate CNS function

      e.g. crystal meth, cocaine, caffeine
- Hallucinogenics
    - Distort perception

      e.g. psylocybin, acid
- Cannabis
    - Alters experience

Three essential factors for predicting and understand drug-related alterations of consciousness:

Drug variables:

- Drug class

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- Qu ity
- Ing ion method

Sc

-

Setting variables:

- Physical
- Social environment

Daydreaming

- Overall daydreaming rate is ~25% (5-50% range)
- No gender differences in the daydreaming rate
- Modest inverse correlation between age and daydreaming rate
- Modest inverse correlation between exam scores and daydreaming rate
- Correlation with seating position

Meditation

- Alters the normal flow of conscious thoughts
- Focuses on stuff that is usually in the background of awareness
- Mindfulness

Hypnosis

Is a person's consciousness really altered in hypnosis?

Barber (1964) says no. Hilgard (1965) says yes.

Sensation and Perception

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Definitions

Sensation – how a physical stimulus first registers on your sensory system.

- Light hitting the retina
- Sound waves hitting the cochlear

Perception – how your brain processes sensory information.

- You figuring out the light and sound is because a person is standing in front of you

Principles of Perception

1. Signal detection theory
2. Visual illusions
3. Neuropsychology
4. Neuroscience

Signal Detection Theory

Standard technique used in perception research. Attempts to get a better picture of the 'signal' by identifying 'noise'.

'Hits – false alarms' gives a better idea of what people can actually see/hear/etc. than 'hits' that are correct.

		Response
Condition	Yes	No
Stimulus	+$10	-$10
Not stimulus	-$1	+$1

This matrix will produce a 'yes' bias.

Illusions

Illusions illustrate the 'shortcuts' the brain takes in trying to figure out the world. Exploits flaws in the brain.

Neurophysiology

Studying the structure of the brain can give us important information about how perception works.

E.g. there are difference pathways from the eye to the brain for motion and colour information.

The Eye

- Turns photons into neurosignals
- Can see a single photon
- Pupil adjusts for the amount of light received
- Lens focuses light so that your retina gets and upside-down back-to-front image of the visual scene.

The Retina

1. Light entering the eye triggers a photochemical reaction in rods and cones at the back of the retina.
2. The chemical reaction in turn activates bipolar cells.
3. Information is then sent to the visual cortex via the thalamus.

Rods are better for night vision as they receive light as only black and white.

Cones receive colour.

The optic nerve -> one path does motion the other does colour.

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The Primary Visual Cortex

Experiment: measured electronic impulses in cats' brains.

Hubel & Wiesel

- Some neurons fire when they see a line at 90°
- Other neurons fire when they see a line at 60°

The area Hubel & Wiesel looked at in cats is called V1 in humans.

V1

Varies in size

- People with a larger V1 area are less likely to be fooled by the Ebbinghaus illusion
- Perhaps the bigger the area, the fewer shortcuts the visual cortex takes.

Face Perception

Right hemisphere.

- You recognise people based on the configuration and size of facial features.
- When you see a lot of faces in quick succession, your brain automatically exaggerates the differences between the configurations and sizes of the faces.
- When you have to recognise someone quickly, it may be efficient to exaggerate their features

Prosopagnosia

- 2.5% of the population have congenital prosopagnosia – they are 'face blind'.
- Congenital prosopagnosia may occur because of limited connections between the visual cortex and the Fusiform Face Area.

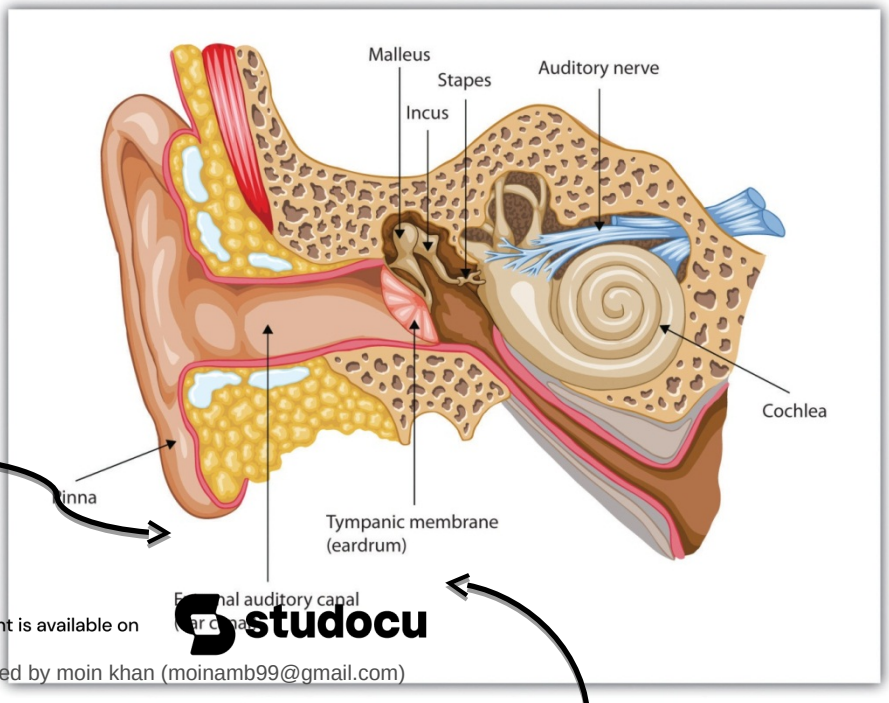
Auditory Illusions

- Sound has many fewer 'bits' than sight
- Sound is processed much faster and with much higher temporal resolution than sight.

The Auditory System

The Ear

The outer ear: the shape changes the sounds that enter your ear depending on where they come from



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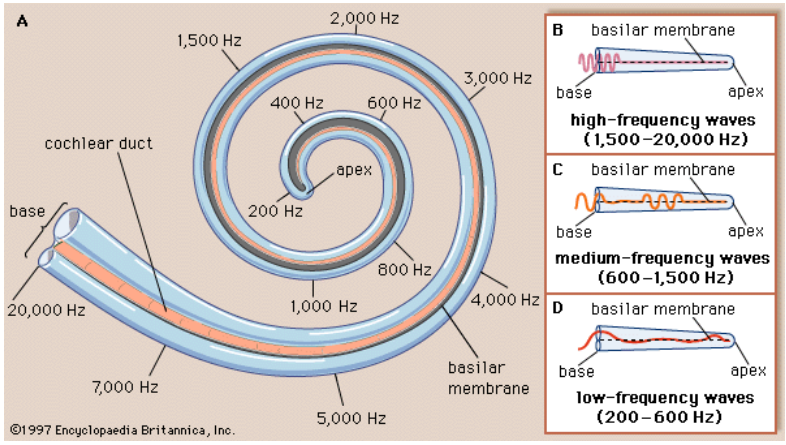
The tympanic membrane: effectively converts soundwaves into vibrations

The malleus, incus and stapes: they amplify the sound

The Cochlea

- The cochlea's 'hair cells' are triggered by soundwaves.
- Different pitches trigger different parts – the longer the wave the further down it travels.
- Triggering hair cells activates neural signals.

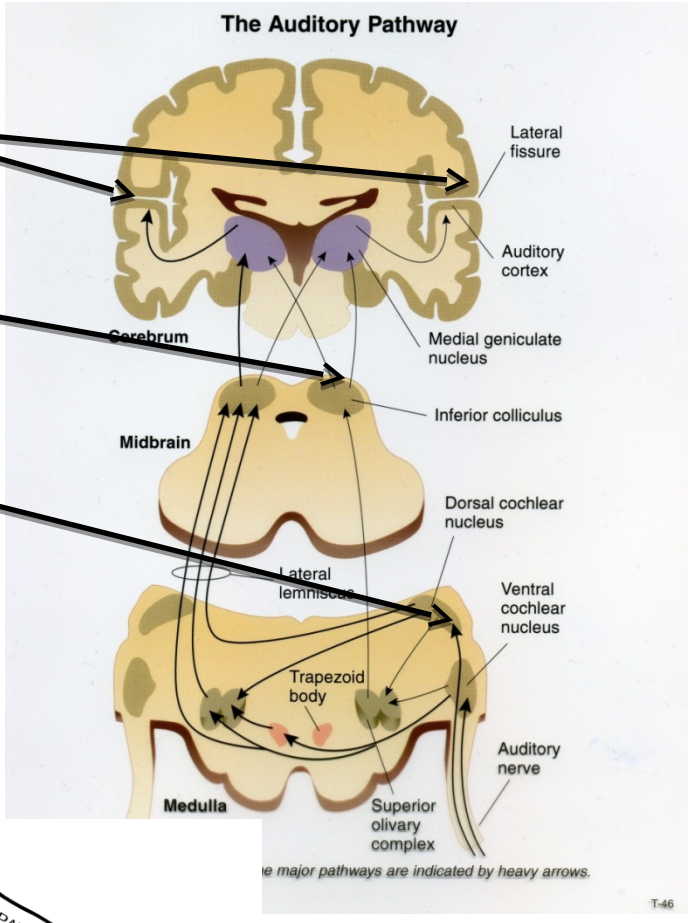


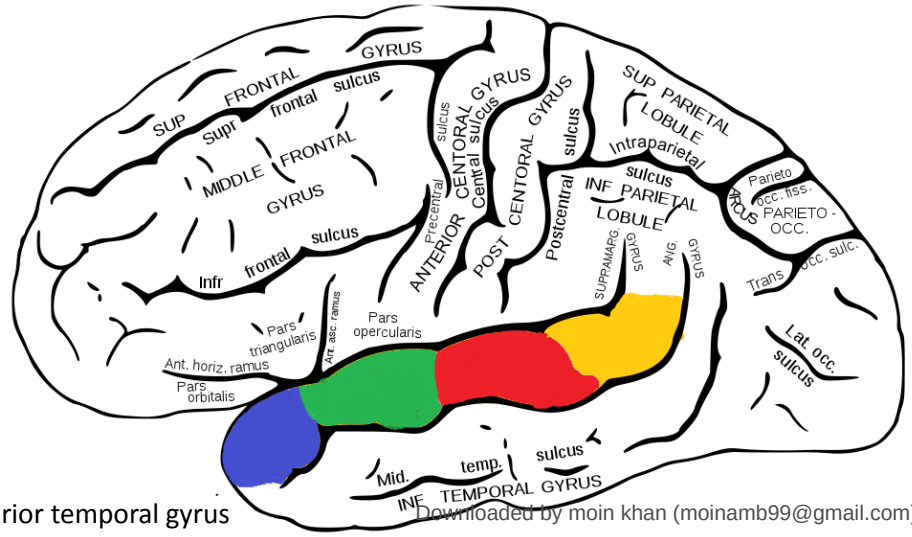
The Auditory Pathway

The path goes from the inferior colliculus, relayed through the thalamus, to the auditory cortex.

The brainstem then feeds to inferior colliculus, which is involved in the 'startle reflex' and figuring out where sounds come from.

Auditory nerve feeds to the brainstem, which fuses *binaural* information from each ear.





Superior temporal gyrus

The Auditory Cortex

- The auditory cortex processes pitch – there is a 'tonotopic' map where we can see which neurons respond to which pitches.
- Similarly, the auditory cortex also processes

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timbre: there are two mpas of 'vowel space' – one for 'front vowels' (i.e. a, e, i) and one for 'back vowels' (i.e. o, u).

Music

- Babies appear to understand music sooner than language.
- Evokes emotions. The interplay between what you expect and what you don't expect causes you to feel emotions
- Schematic expectancies are what you expect based on all the music you've heard in the past.
- Veridical expectancies are what you expect based on having heard the song before.

Schematic Expectancies

Your brain has a good idea about what is statistically likely.

- Music which is entirely statistically likely is boring
- Music which is really statistically unlikely is weird – we don't like it.

But music that plays with your set of expectancies evokes emotions.

- We expect steps rather than leaps in melodies
- We expect notes to be as long as each other
- We expect chords to follow similar chords

Musicians create tension by doing statistically unlikely things. They release that tension by:

- Returning to what you'd typically expect
- Surprising you by going somewhere different

Musicians vs. Non-musicians

Musicians' brains are different:

- More grey matter in the auditory cortex
- Larger corpus callosum

Musicians are more conscious of things such as bitonality.

However, non-musician brains still process these things regardless of conscious acknowledgement.

Integrating the Senses

In order to make sense of the world we have to put together information from different senses. Our memories and expectations *after* how we put that information together. Other senses include:

- Balance
- Temperature
- Proprioception (where your body is)
- Pain
- Internal senses (e.g. hunger)

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Synaesthesia

Synaesthesia is the stimulation in one sensory pathway leading to activation in another sensory pathway. E.g. hearing a word and seeing a colour.

The McGurk Effect

Audio Word	Visual Word	Perceived Word
Been	Beep	Beam
Cap	Can	Cat
Cap	Con	Cot
Bait	Gate	Date
Bay	Gay	Day
Vet	Get	Debt

Classical Conditioning

Discovered by Pavlov

An association between a stimulus and an instinctual response.

Conditioning is what happens when an organism acquires an association between a stimulus and a response.

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Organism: something living. The principles of learning apply to amoebas, pigeons, humans.

Association: Connection between something in the environment and a behaviour. You might have an association between seeing snakes and feeling fear.

Stimulus: Anything you can perceive

Response: An observable behaviour.

Terminology

Unconditional Stimulus (US)

A stimulus that naturally elicits a response from an organism.

Unconditional Response (UR)

A response that is naturally elicited by a stimulus.

Conditional Stimulus (CS)

A stimulus that does not naturally elicit a response from an organism.

Conditional Response (CR)

A response that is now elicited by a CS due to conditioning.

Acquisition

- Before an organism is conditioned, there's an acquisition phase.
- Often takes repeated trials to associate the US with the CS so the CR develops.
- CR acquisition's speed and strength is affected by the strength of the US.

Extinction

- CRs don't diminish over time
- However, if you repeatedly present a CS *without* the US the CR will disappear
- This is extinction

Spontaneous Recovery

If you acquire a CR on Wednesday, extinguish it on Thursday and then present the CS again on Friday, the CS might get a CR again.

Generalisation

When a subject learns that similar stimuli also elicit the response.

Discrimination

When a subject learns that only a very specific range of stimuli elicit the response.

Time

Generally, the closer in time the US and CS are presented, the more effective the conditioning. However, if the US and CS are presented simultaneously, the conditioning is less effective than if the CS is presented first.

Taste aversion is learnt via classical conditioning.

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Operant Conditioning

Discovered by B.F. Skinner

How behaviour is altered based on the response to that behaviour.

Skinner thought operant conditioning could explain *everything* about behaviour.

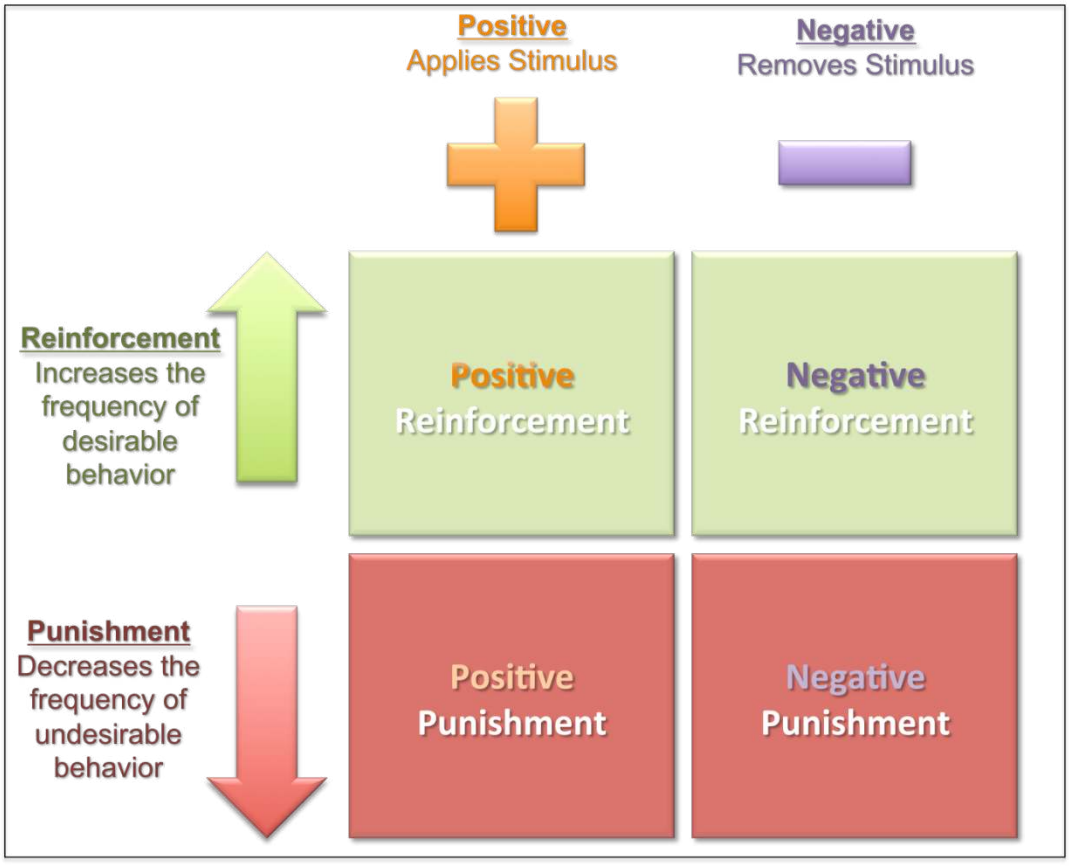
Kinds of Conditioning

Reinforcement vs. Punishment:

- Reinforcement **increases behaviour** (and isn't necessarily rewarding).
- Punishment **decreases behaviour** (and isn't necessarily irritating).

Positive vs. Negative:

- Positive **adds something** (and isn't necessarily good).
- Negative **takes something away** (and isn't necessarily bad).



Effectiveness

- Reinforcement is more effective.
- Punishment isn't as permanent as reinforcement
- Individuals are only motivated to show you when they're being reinforced and punishment reduces trust/increases aggression.

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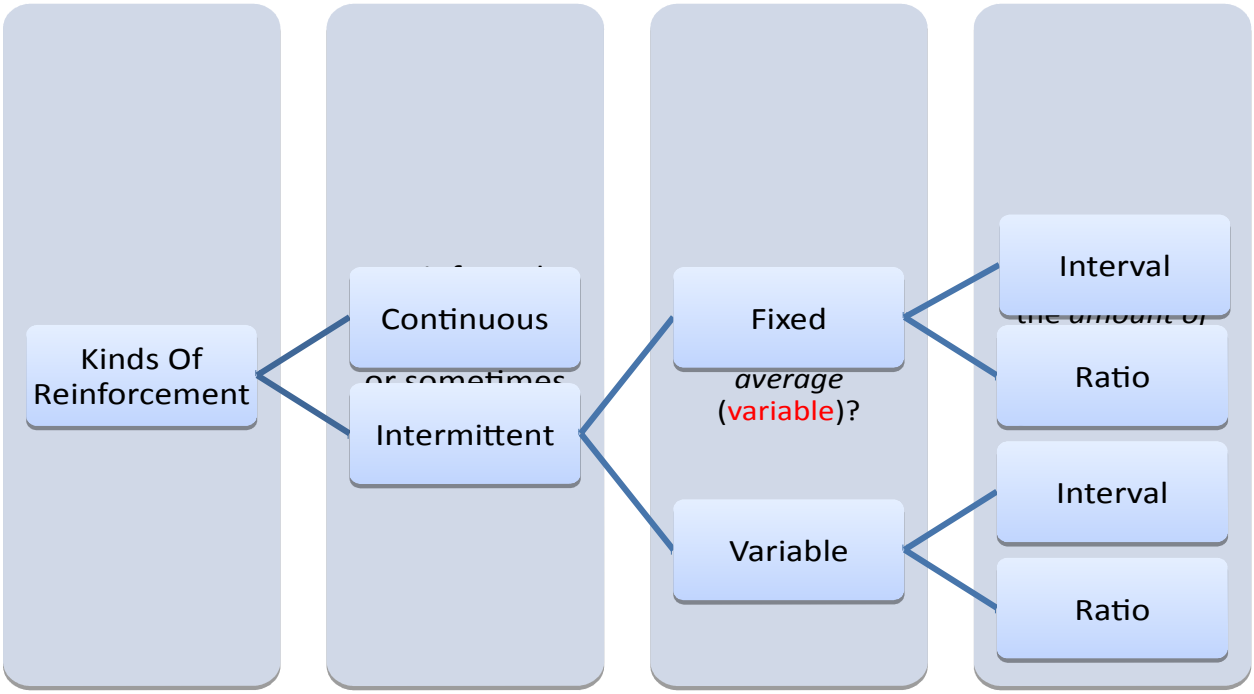
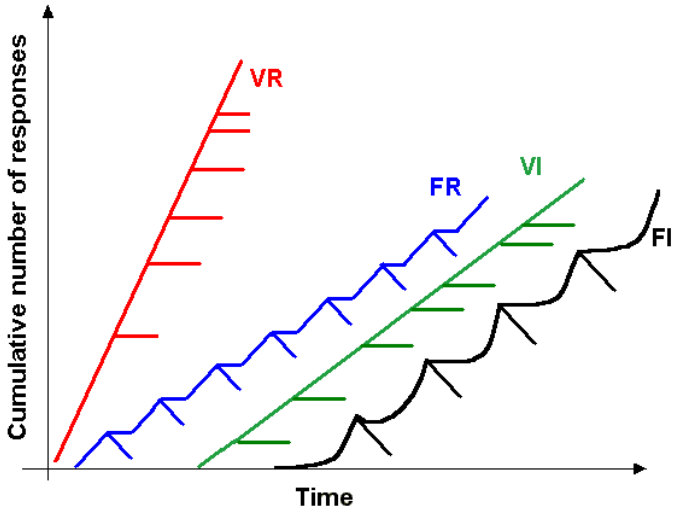
Reinforcement Schedules



The variable-ratio reinforcement schedule is the most effective because it is unpredictable.



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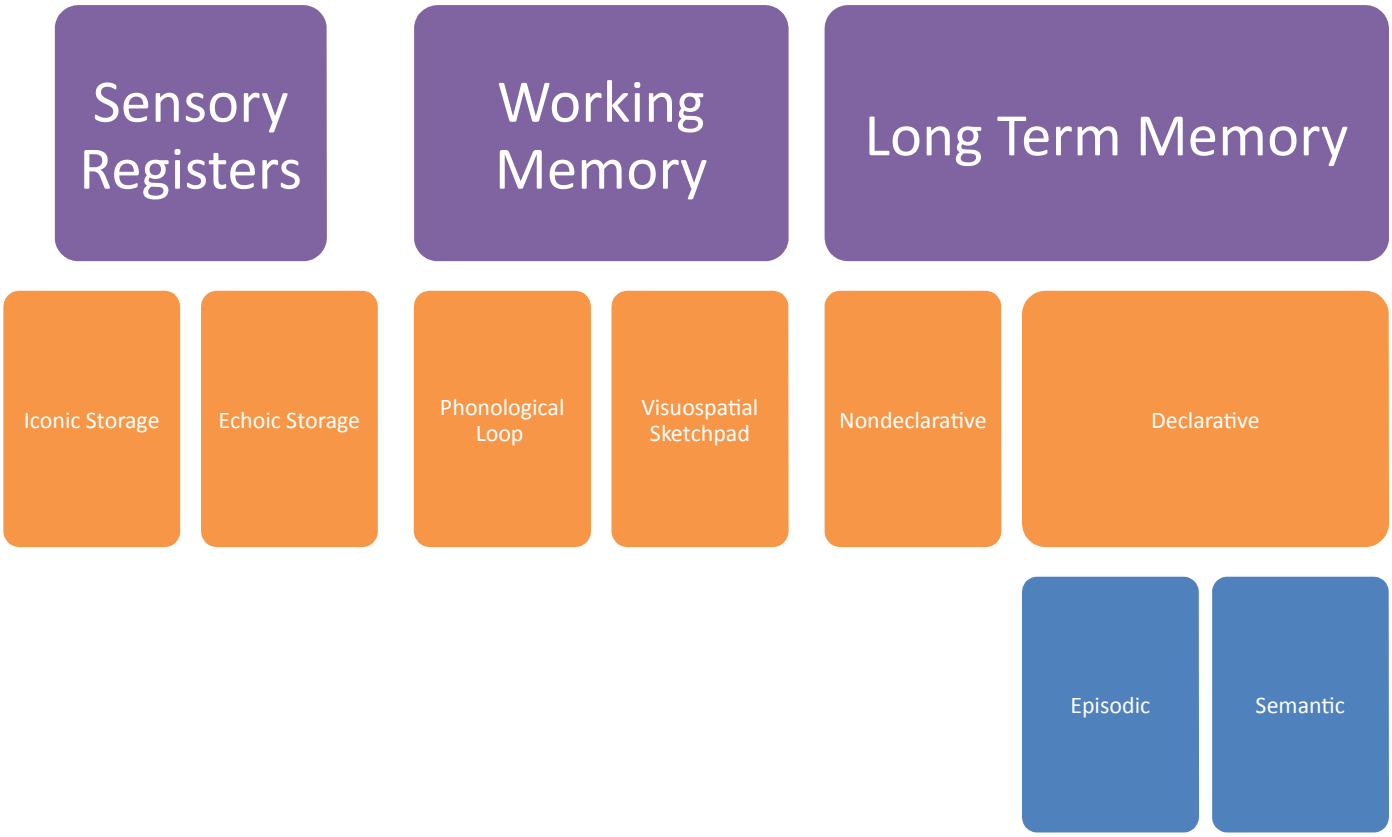
Memory



Sensory Registers

- Iconic memory: memory of just seen
    - Very high resolution
    - Lasts 250ms-4s
- Echoic memory: memory of just heard
    - Very high resolution
    - Lasts 4s-20s

Iconic Memory

- *Change blindness* occurs partially because a flash between images resets iconic memory.
- Once a difference a difference has to be found, you can only rely on working memory.

Working Memory

- Also called short-term memory
- Holds information for ~7-30s
- Different verbal and visual stores

Chunking

- You can memorise some things because your memory does something called chunking.
- Instead of having to remember a lot of separate words, you have to only remember a couple of phrases.

Primacy and Recency

- We are better at remembering items at the beginning of lists (primacy)
- We are better at remembering items at the end of lists (recency)

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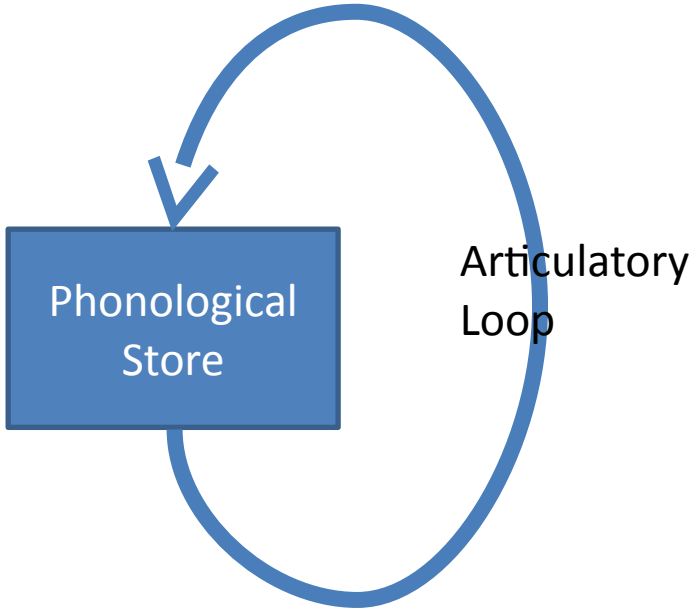
Baddeley's Working Memory Model

- There are two main parts of *verbal* working memory:
  - A phonological short-term store
  - An articulatory loop
- The short-term store stores the last 4±1 words heard
- The articulatory loop is you saying the words to yourself.



Long Term Memory

- There are two main types of long term memory:
  - Procedural
  - Declarative
- Procedural is knowing *WHAT*
- Declarative is knowing *THAT*

Declarative Memory

Two kinds:

- Episodic
- Semantic – general knowledge

Episodic Memory

- Memory is reconstructive
- We remember the last time we told the story rather than what actually happened
- Chinese Whispers

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Language in Cognition and the Brain

- Perception (the McGurk Effect)
- Working memory (we extended it by talking to ourselves
- Long-term memory (semantic)
- Learning (Chomsky vs. Skinner)
- L Broca's area – language production
- L Wernicke's area – language comprehension
- R Wernicke's area – body language comprehension
- The 'Laryngeal Motor Cortex'
- We use *words* to think about decisions
- Vowel maps in the auditory cortex

The Language Instinct

- Language is at least partly *instinct*
- Instinctual sentence structure
- The idea that the language you speak determines how you think is called the Sapir-Whorf hypothesis.
    - This is false – language affects but doesn't determine your though
    - This is true – sometimes determines thought.
- Processing words is automatic

Taboo Words

Stroop tests using rude words are slower due to stressful association. We can't help reacting emotionally to shunned words. The basal ganglia seems to designate taboo words and monitor them.

The Reading Instinct?

- Have been making communicative noises for far longer than we've been reading
- 16.3% of the world is still illiterate

Dyslexia

- The newness of reading is likely why 15% of people have dyslexia.
- Some people with dyslexia have better peripheral vision/a wider visual field.

Recognising Words

Left hemisphere equivalent to the Fusiform Face Area is the Visual Word Form Area.
Two different pathways in the VWFA:

- The dorsal (top)
- The ventral (bottom(

The ventral pathway processes writing that is in familiar fonts, straight lines, etc.

The dorsal pathway processes writing that is harder to read – weird angles, strange spaces, etc.

Comic Sans Effect

People remember things better if they are written in an unfamiliar font. This may be because unfamiliarity with the font means that the dorsal pathway is used and so the material is read more carefully and slower because it is unfamiliar. This means it is more processed.

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Reading Scrambled Text

- We use context when we read
- It’s easier/quicker for us in general to read letters at the start and end of words.
- It’s easy to miss misspelled words because you know what they’re meant to say.

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Decision Making

Our brains have to balance between accuracy and efficiency. Perceptual illusions work because they exploit the shortcuts in our visual systems.

Accuracy vs. Efficiency

Decision making is a balance between accurate and efficient (like perception). The brain has two systems: one for accuracy; one for efficiency.

System One: Efficiency

- Fast, automatic, unconscious, effortless
- Feels like 'intuition'
- Does most of the work
- Puts you in a good mood

System Two: Accuracy

- Slow, deliberate, effortful
- Feels like making a choice/concentration
- Is lazy in use
- Puts you in a bad mood

Cognitive Biases

Confirmation Bias

The tendency for people to search for confirmation of what they already believe. Falsification.

Risk Aversion

We dislike risk and are more biased towards taking the option with less/no risk.

Representative Heuristic

People categorise by matching the similarity of an object or incident to a prototype, but ignore information about its probability of occurring.

Availability Heuristic

People infer the frequency of something on the basis of how readily it comes to mind. People assume that event or occurrences that they can recall easily are common and typical.

The Anchoring Effect

Distracts you with unrelated information that you believe is important, therefore making your final answer incorrect due to being 'anchored' elsewhere.

The Moses Illusion

Documented illusion which confuses your system one and system two.

Priming

A system one function which uses the context of recent stimulus to apply. Prior exposure to a stimulus facilitates or inhibits the processing of new information.

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The Halo Effect

Assuming the whole story based on one attribute/fact

Panglossianism

We like things more when they're ours. Rate things more highly once you are involved in them.

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Sleep

Insomnia

Definition: Difficulty falling/staying asleep despite adequate opportunities, which causes daytime impairment/distress and which happens at least three times a week for a month.

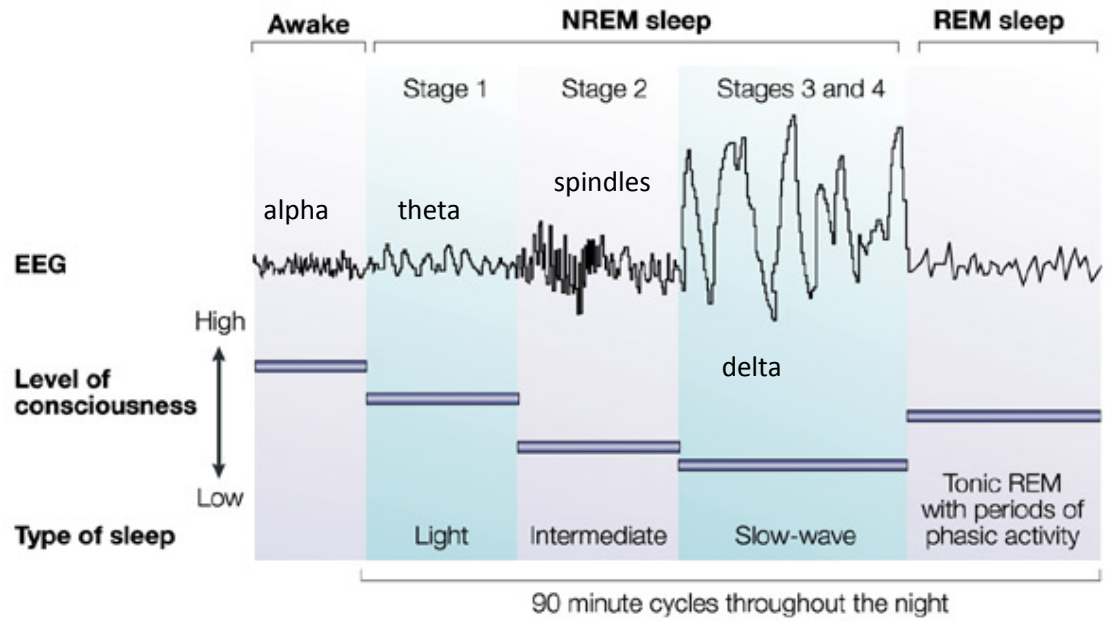
Insomnia affect ~10-40% of the population. 40% of people with insomnia have a comorbid psychological disorder.

Treatments

- Progressive relaxation
    - Systematically tensing and releasing every muscle group in your body
- Developing good sleep habits – stimulus control
    - Bed is only for sleep
    - Do not lie in bed for more than 10 minutes
    - No daytime naps
    - Get up the same time each morning
- Paradoxical intention
    - Telling yourself to stay up – harder to fall asleep when trying under stressful conditions.

Stages of Sleep

- Stage 1: alpha waves disappear and theta waves start to appear. Most people don't count this as sleep. Body starts to become paralysed for sleep.
- Stage 2: easily wakened. Dreaming is rare 'sleep-spindles' and K-complexes appear.
- Stage 3 & 4: 'Delta sleep' or 'slow-wave sleep'. Lasting groggy feeling if woken. Parasomnias. More towards the start of the sleep period. ~50% of people recall dreaming at this stage.
- R.E.M.: ~83% of people recall dreaming at this stage. More towards the end of the sleep period. Stands for 'Rapid Eye Movement'. Though your eyes are closed, your eyes move. Brain activity similar to waking hours. Parasomnias.



Nature Reviews | Immunology

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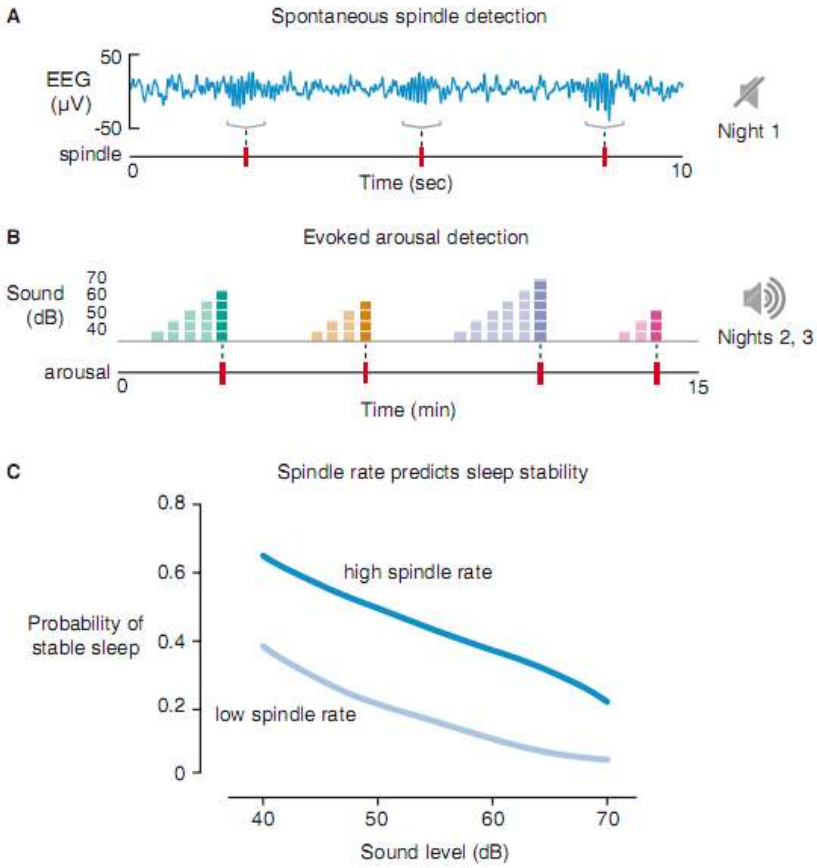
Sleep Spindles

- Measured frequency of sleep spindles on quiet and loud nights
- People with more sleep spindles slept better
- Sleep spindles are thalamocortical signals that hinder transmission to external signals.



Purpose of Sleep and Dreams

Two studies:

- Ellenbogen: interferences & sleep with remembering set words
- Wamsley: Sleep between completing a virtual maze

These two studies found evidence that suggest that sleep facilitates hippocampus tasked memory consolidation. Defragments the mind (memories).

Circadian Rhythms

Over the course of the day our bodies have certain 'rhythms' (body temperature, melatonin, cortisol).

Melatonin:

- Usually produced based on exposure to natural light
- Administering an hour before bedtime can promote sleepiness

Cortisol:

- Associated with stress
- Increased cortisol level may disrupt memory consolidation leading to fragmented dreams later in the sleep period.

Delayed Sleep Phase Disorder

- Form of insomnia where circadian rhythms are 'late'.
- Lack (1986) found that 17.6% of SA first-year psych students had this.
- Students with DSPD had a lower GPA (students with regular insomnia did not).

Sleep Deprivation and Cognition

Research has found that the following are affected by sleep deprivation:

- Visual perception
- Learning/conditioning
- Working memory performance
- Language ability
- Attention

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- Decision Making

Much more common than full sleep deprivation is chronic sleep restriction. Two weeks of six hours sleep a night is equal to one night of full sleep deprivation.

All available studies show that chronic decreased sleep time is associated with decreased grades.

Fatal Familial Insomnia

Genetic condition often found in middle aged humans. They start to be unable to reach stage 2 sleep. The thalamus is damaged/prions. Worsening deficits to attention and vigilance and long term working memory. It is fatal within 9-35months after onset.

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